

RASC Submission Form

Title: Human Exploration of the Moons of the Outer Planets

Sponsoring NASA Enterprise Code: M

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Introduction:

Consideration of human missions beyond Mars exceeds the horizon of even the most advanced planning activities within NASA. During the next twenty-five years, robotic spacecraft are envisioned to explore Europa (a moon of Jupiter) and Titan (a moon of Saturn). Both moons have environments that could possibly be suitable for the existence of life. The discovery of evidence of life at either location would provide a compelling rationale to send human explorers.

Human exploration of the moons of the outer planets will most certainly require breakthroughs in the technologies of propulsion and power; radiation protection; artificial gravity; and vehicle reliability, autonomy, and robustness.

Submittal Description:

A successful human mission to a target destination at the outer planets or within the main asteroid belt will require significant breakthroughs in several critical technologies. In particular, four technologies stand out: propulsion and power; radiation protection; artificial gravity; and spacecraft reliability, autonomy, and robustness.

(1) Propulsion and Power

Trip times will need to be reduced dramatically from those of robotic spacecraft, such as Galileo (to Jupiter) and Cassini (to Saturn). Even propulsion technologies envisioned today as options for a human Mars mission will be too slow for a viable human mission to the outer planets.

It is envisioned that advanced propulsion may require large power. At distances farther out than Mars, solar energy is most-probably not an option. Additionally, robust crew activities for exploration on a celestial body will demand large power.

The RASC Team is requested to assess possibilities for revolutionary propulsion capabilities available in twenty-five years that will provide trip times to Jupiter on the same order of magnitude as trip times envisioned for human Mars missions. The RASC Team is further requested to evaluate possible sources of power commensurate with propulsion and exploration needs.

(2) Radiation Protection

New concepts for protection from radiation will be required during flights in interplanetary space. However, of greater concern is the radiation environment in the vicinity of Jupiter (and to a lesser extent, Saturn). Jupiter's strong magnetic field creates an extremely hostile radiation environment. Advanced schemes for protecting both humans and equipment will be required.

The RASC Team is also asked to consider the protection of a single crewmember outside of the spacecraft (conducting an EVA) exploring the surface of a moon such as Europa. How can the individual, as well as the spacecraft, be protected from the harsh radiation environment?

(3) Artificial Gravity

Even with breakthrough advances in propulsion technologies, the crew is still likely to spend significant time traveling to and from their distant destination. Artificial gravity should be evaluated as a technique for maintaining crew health and vitality during the lengthy transits. The RASC Team is asked to evaluate advanced concepts for providing artificial gravity for a spacecraft on a long duration mission.

(4) Vehicle Reliability, Autonomy, and Robustness

Due to the considerable length of time between launch windows-of-opportunity to the outer planets, the crew will depart Earth with essentially no hope of resupply or rescue. Consequently, the vehicle they use must be reliable far above any spacecraft yet built. And operating so far away from Earth, there can be no "real time" reliance on flight controllers in the Mission Control Center. Vehicle systems must operate in a highly autonomous manner. The RASC Team is asked to evaluate the capabilities that may be available in twenty-five years to contribute to vehicle reliability, autonomy, and robustness.

Your Estimate Of Assessment Duration: 18 (Months)

Desired Completion Date: March 2002

EXPECTED PRODUCTS	DELIVERY DATE
• Written study/assessment of propulsion and power options	November 1, 2001
• Written study/assessment of radiation protection options	December 1, 2001

• Written study/assessment of artificial gravity options	January 1, 2002
• Written study/assessment of reliability, autonomy, robustness options	February 1, 2002
• Final presentation summarizing RASC activities	March 1, 2002

List of Attached Graphics: none